who served as astronomer; Dr. H. Alme, of the Meteorological Office at Stockholm, who joined the expedition at Tromsoe and served as meteorologist. The general spirit of the expedition was not that of scientific exploration, but the two gentlemen here referred to accomplished all that was possible under the circumstances In 1895 the Chief of the Weather Bureau received from Dr. Alme his report communicating the meteorological results, and on consultation with Mr. Wellmann was assured that there was no objection to the publication of this report, but that he considered Mr. French as responsible for all the work. Accordingly correspondence was opened with Mr. French, who, after unforeseen delays, owing to his absence in the field work of the Coast and Geodetic Survey, has only lately been able to complete the reduction of his astronomical observations and give the proper locations and charts showing the points at which the meteorological work was done. The Editor takes pleasure in being able now to announce that the combined reports of Messrs. French and Alme will be printed as a bulletin of the Weather Bureau. It is always proper and important to publish, in all possible detail, any observations made at an isolated point so far removed from ordinary meteorological stations, and so essential in filling up the daily map for tracing storms and weather over the North Atlantic Ocean.

RAINFALL MEASUREMENTS ON SHIPS.

It has been customary for navigators, in keeping a meteorological record, to express the rainfall only in the most general terms; but, inasmuch as a complete study of the meteorology of the globe requires a positive knowledge of the amount of rainfall, it behooves us to make every possible effort to remedy this great deficiency in our knowledge. In former days it was assumed that the rain gauge must be a fixture with its mouth perfectly horizontal at an elevation of not more than 1 foot above the earth's surface, while a gauge set in a shallow pit so that its mouth is on a level with the surrounding soil was widely adopted as the standard. The invention of shielded gauges by Prof. Joseph Henry, in 1858, and Professor Nipher, in 1878, and of the protected gauge of Bœrnstein, in 1884, together with a better appreciation of the action of the wind upon the gauge, as affecting its catch, have effected a radical change in our views. The height of the gauge above the ground does not materially affect the catch or the apparent rainfall, provided that we adopt some method of annulling the influence of the wind. Shielded or protected gauges give the same rainfall in all open localities, and it seems to be high time that they should be established and used at sea. The errors to which such gauges will then be subject will arise principally from the fact that they are liable to be in the shelter of a sail or bulwark, of a deck house or a smokestack. If established on a steamer near each end of the bridge occupied by the pilot or navigating officer, the average of the two gauges can apparently only be affected by the influence of the rolling of the vessel, and if mounted on gimbals, this latter is reduced to a minimum. If established on a steamship or sailing vessel, the gauge that is to windward of the sail should be employed; but the gauge that is to leeward should be read and recorded, in order to appreciate the amount that it has lost by its sheltered position.

The latest effort in this line of work is that of Dr. W. G. Black, whose paper on this subject, read before the Manchester Geographical Society in October, 1897, is summarized on page 206 of its Journal, Vol. XIII. The complete paper is published, with a chart of ocean rainfall, in the same Journal, Vol. XIV, pp. 36–56. Rainfall tables are given for each ocean, based on observations made with marine rain gauges (generally Dr. Black's pattern of 1870–72), during many voyages between 1864 and 1880, by about twelve steamships or steamers. Dr. Black illustrated his address and explained the use of the large box and small leather rain gauges; the gimbal stand for the rain gauge, with its ring and dish and louvre protection, and, finally, the wind gauge. The following are the conclusions to which Dr. Black has come on the question of oceanic rainfall:

1. More rain falls at sea in the Northern Hemisphere (Atlantic, Indian, and China seas) than in the Southern Hemisphere, by 91.15 inches to 66.33 inches; but there are fewer rainy days, by 162 to 182.

2. The rate of rainfall is heavier in the Northern Hemisphere than in the Southern Hemisphere by 0.562 inches to 0.364 inches per diem of wet days.

3. The percentage of wet days to total days in the Northern Hemisphere is about 24, and in the Southern Hemisphere is 23.

4. Most rain was collected in the month of September in the Northern Hemisphere, and in April in the Southern Hemisphere, both being autumn months.

5. The rate of rainfall per annum in the Northern Hemisphere was 50.56 inches and in the Southern Hemisphere 30.76 inches, or two-fifths less.

6. Least rain was collected in March in the Northern Hemisphere and in October in the Southern Hemisphere, both being spring months.

7. The greatest number of rainy days in the Northern Hemisphere was in September, 33, and in the Southern Hemisphere in April, 25; autumnal months.

8. The least wet days in the Northern Hemisphere were in March, 5; in the Southern Hemisphere, 1, in October; spring months.

We have, unfortunately, no further details of Dr. Black's apparatus, but we have no hesitation in recommending shielded or protected gauges, whether on gimbal stands or not, for general use at sea, as being a great advance over our present absence of rainfall measurements.

CLIMATES OF GEOLOGICAL AGES.

An article by Prof. T. C. Chamberlin in the Journal of Geology for November, 1897, vol. V., p. 653, contains a review of a number of hypotheses bearing on climatic changes during geological ages. In common with all modern geologists, Professor Chamberlin recognizes that the atmosphere is the most active of all geological agencies.

> Its very activity destroys its relics almost as soon as formed and gives them peculiar evanescence. This has invited the neglect of geologists laudably prone to concentrate their attention upon agencies which have left enduring and unequivocal records. * * * All our attempts at the solution of climatic problems proceed on some conscious or unconscious assumption concerning the extent and nature of the atmosphere at the stage involved.

After showing that the carbon dioxide now in the atmosphere would not last ten thousand years at the present rate of consumption, and that we are confronted by the necessity of finding some compensating source of supply, he appeals to the ocean as being an atmosphere in storage, holding in solution about eighteen times as much carbon dioxide as does the atmosphere itself. He finds that the flora and fauna of Paleozoic and Cenozoic times do not imply any great difference between the earlier and the present atmosphere, but that during the Carboniferous period there may have been many thousand times as much carbon dioxide as now. One might assume that our atmosphere has been successively fed and robbed of this gas. After computing from the best data available the power of a hot atmosphere and molten earth to retain the various gases whence it follows that hydrogen, at least, would escape into space away from the earth's attraction quite